BLISTER SPOT OF APPLE INCLUDING A STUDY OF THE PATHOGENICITY AND PHYSIOLOGY OF THE CAUSAL ORGANISM AND HISTOLOGICAL CONSIDERATIONS

BY

MARION ASHTON SMITH

B.S., Kansas State College, 1922
M.S., Iowa State College, 1925

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SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
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HORTICULTURE IN THE GRADUATE SCHOOL OF
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Introduction

The original investigations of the blister spot disease, caused by *Pseudomonas papulans* Rose (*Phytomonas papulans*) Bergey et al., were carried on at the Missouri State Fruit Experiment Station at Mountain Grove, Mo., in 1916. This work was concerned with studies of the organism in pure culture and pathogenicity studies on the living host.

The present investigation has attempted a more thorough study of the problem, placing particular emphasis on pathological histology, pathogenicity and physiology. Comparative studies with *Phytomonas syringae* van Hall and some other organisms have also been made.

Conclusions

P. papulans the cause of the blister spot disease of apples, was first described in Missouri in 1916. The disease has been reported only in the United States from the states of Missouri, Indiana, Pennsylvania and Illinois and has been found to occur under natural conditions only on apple fruits.

The pathological histology of the disease is discussed. The disease is first apparent as a water soaked area around a blister spot. It may extend .2 to .4 mm below the cuticle. Immediately beneath the diseased area a phellogen layer, from 3 to 5 cells in thickness develops. The bacteria are present intercellularly throughout the region of the papules. In later stages the epidermis over the blister spot becomes black, dies and breaks loose from the surrounding healthy tissue. The occurrence of the small and shallow blisters seems

to indicate that the blister spot pathogen is a relatively weak parasite.

The pathogenicity of *P. papulans* on wounded and non-wounded immature fruits was demonstrated by field inoculations. The incubation period varied from 16 to 21 days. Wound inoculations of apple, plum, cherry and tomato fruits in moist chambers were successful. Wound inoculations of apple, cherry, pear, plum and lilac twigs and leaves of apple, peach, magnolia and lilacs were successful. Needle puncture inoculations of fruits, twigs and leaves of apple with lilac blight organism *P. syringae* were successful. An isolate from an undescribed leaf spot disease of magnolia proved pathogenic to lilac and magnolia foliage. Two isolates from target canker of apples did not prove pathogenic to apple fruit, twigs or leaves. An isolate from an undescribed leaf spot on Rome Beauty apple foliage failed to prove infectious to apple foliage or fruit.

Studies showed that the blister spot organism remained viable on fruits placed outdoors from October 16 to March 15. Reisolations were not successful after that time. It is concluded that blister spots on overwintered fruits do not constitute an infection source in the spring.

A study was made of the morphology and physiology of isolates of *P. papulans* and *P. syringae* and isolates from apple target cankers, and undescribed bacterial leaf spot of magnolia and an undescribed bacterial leaf spot on Rome Beauty apple foliage. The *P. papulans* and *P. syringae* and magnolia leaf spot isolates were found to bear close morphological resemblances. The target canker and Rome Beauty apple leaf spot isolates appeared to be unrelated organisms.

A study was made of the cultural characters of the various isolates on beef infusion agar and broth, on potato dextrose, Patel's, glycerin and malachite green agars and in Uschinsky's Fermi's, Cohn's and asparagin solutions. The media used in the studies of biochemical reactions included gelatin, milk and the media for the production of ammonia, hydrogen sulphide

and indole; the hydrolysis of starch and the reduction of nitrates. In the fermentation studies 31 carbon sources were utilized.

The results of the studies of the physiology of the various isolates indicated that *P. papulans, P. syringae* and the magnolia isolate are very closely related. The target canker and the Rome Beauty apple leaf isolates are consideered unrelated species.

It is concluded that *P. papulans* should not retain specific rank because of its morphological, cultural, and physiological and pathological similarity to *P. syringae.* The pathogen exhibits enough cultural, physiological and pathological differences to prevent its inclusion as a synonym of *P. syringae.* Because of these differences, *P. papulans* is considered a variety of *P. syringae* and should be designated *Phytomonas syringae var papulans n. var.* Following is a technical description of the proposed new variety:

Phytomonas syringae var. papulans n. var.: A short rod, 1 to 2.8 microns long by 0.7 microns wide, occurring singly, although occasionally in pairs or short chains. It is motile by one to three polar flagella; no spores or capsules have been demonstrated; the organism is Gram-negative but stains readily with the ordinary bacterial stains; the organism is not acid fast; forms round, white, opalescent colonies on beef infusion agar; clouds bouillon and forms a pellicle; liquefies gelatin rapidly, produces green fluorescence in beef infusion and asparagin media and glycerin agar, produces mahogany brown color in modified Czapek media, reduces litmus and brom cresol purple milk; produces ammonia but no indole or hydrogen sulphide; no nitrate reduction; no diastatic action on starch; grows in Uschinsky's and Fermi's solutions but very feebly in Cohn's solution; produces acid from arabinose, xylose, dextrose, levulose, galactose, mannose, sucrose, glycerol, mannitol, sorbitol, salicin, esculin, but not from rhamnose, maltose, lactose, trehalose, raffinose, melezitose, starch, inulin, dulcitol, arbutin; produces alkaline reaction in glycogen, and in citric, malic, lactic, formic, succinic and acetic acids; no gas, is a faculative anaerobe; optimum, minimum and maximum temperatures for growth are 27, 3.5 and 34.5 degrees respectively; optimum, minimum and maximum pH values for growth are 7.2, 5.0 and 9.4 respectively; thermal death point is 52C.

VITA

Marion Ashton Smith was born January 27, 1897 in Oberlin, Kansas. He attended grade school in Oberlin, Kansas, and high school in Topeka, Kansas, graduating from high school in 1915. In the fall of 1916 he entered Kansas State College, Manhattan, Kansas. He enlisted in the U. S. Army in April, 1917 and was discharged from the service in May, 1919. He re-entered Kansas State College in September, 1919 and received his B. S. degree from that institution in June, 1922. He entered Iowa State College in January, 1923 and received his M. A. degree from that institution in 1925. From 1924 to 1927 he was an agent in the U. S. Department of Agriculture, Office of Cereal Crops & Diseases. In August, 1927, he accepted a position as Research Assistant with the Crop Protection Institute with headquarters in the Department of Horticulture, University of Illinois. On August 1, 1931 he resigned this position to accept the position as Associate Pathologist, Division of Fruit & Vegetable Crops and Diseases, U. S. Department of Agriculture and is so employed at the present time.

He is a member of Gamma Sigma Delta, Sigma Xi and Beta Theta Pi.

He has published:

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